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ORIGINAL PAPER

ELECTRODIAGNOSTIC DEFINITION OF THE SITE AND NATURE OF PERIPHERAL NERVE LESIONS*

BY PHILIPPE BAUWENS

From St. Thomas's Hospital, London

HITHERTO advances in electrodiagnosis of peripheral nerve lesions have been related to history and geography. Wars have produced epidemics of peripheral nerve injuries, while industrial areas have supplied this commodity, so essential for study and research, on a more endemic scale. The application of electronics to the electrodiagnostic armamentarium in the shape of accurate stimulators and versatile electromyographic equipment has changed this situation; not so much in respect of peripheral nerve injuries of acute traumatic origin as of more subtle lesions of a more chronic nature. The reason for this is that these modern techniques provide for the measurement of a greater number of parameters of diagnostic significance.

Until recently the velocity of conduction along a nerve fibre and its relation to the calibre of the fibre was of only academic interest to the clinician. To-day it has acquired an unexpected importance (Hodes *et al.*, 1948; Lambert, 1956; Simpson, 1956; Gilliatt and Thomas, 1957). The same applies to the detection of gross changes in thresholds of excitability, of signs of minimal denervation, and of auto-excitation of nerve fibres through irritation or compression.

Despite the immense strides made during and immediately after the Second World War, the situation as regards peripheral nerve injuries revolved round three distinct types of conditions: neurapraxia, axonotmesis, and neurotmesis

* Paper read at a joint meeting of the Heberden Society and the British Association of Physical Medicine, Buxton, July 25 and 26, 1959.

—the last two implying axon degeneration with partial or total denervation of the muscles supplied by the affected nerve. Other possibilities were dimly suspected, but found no confirmation.

In the light of more recent and precise investigations in nerve-compression syndromes it would appear that another two conditions have to be contended with. Both can be envisaged as the result of a progressive obliterating process involving nerves with a gradual reduction of the cross-section of the axoplasm. It would appear that this reduction in calibre is, in the first instance, localized solely to the site of the compression and might, for convenience, be referred to as "axonostenosis". There is, however, some evidence that in long-standing cases the reduction in calibre does not remain confined to the compression zone, but affects the whole length of the fibre distal to it. This secondary condition, which might be termed "axonocachexia", is explicable on the grounds that the sole source of the axoplasm which fills the nerve fibre is the anterior horn cell, whence it is propelled along the whole length of the fibre to its peripheral extremity.

In a paper entitled "The Life History of the Neuron", Paul Weiss (1956) describes this process and adduces convincing experimental work not only in support of this theory, but to the effect that a constant metabolic consumption takes place along the whole length of the nerve fibre. It follows that any substantial obstruction to the axoplasm flow must cause a distal depletion.

The modifications in characteristics which result from local axonostenosis —with or without axonocachexia—appear to be in accord with the neurophysiological principle that the excitability of a nerve fibre, and the velocity of propagation of impulses along it, are determined by its girth. Thus a reduction in calibre produces both a rise in the threshold of excitability and a decrease in the velocity of conduction.

In terms of neuropathology, it seems that compression of a nerve can lead to one or all five of the following states in the motor fibres (Plate IX, Fig. 1)*: normality; neurapraxia; axonostenosis; axonocachexia secondary to axonostenosis; and axonotmesis. In terms of electrodiagnosis each of these states exhibits its own characteristics, which are best demonstrated by electromyographic exploration of one or more muscles supplied by the affected nerve during stimulation of the nerve—if possible above and below the suspected level of the lesion.

In *normal nerves*, the velocity of impulse conduction being near enough the same in all nerve fibres and uniform along the whole length, the action potentials

* This paper was illustrated by an animated film depicting the result of these various conditions on the velocity of propagation of nervous impulses and on the time-course of the muscle response.

of the motor units supplied by them summate to assume a compact pattern on the cathode-ray tube or photographic record. Moreover, this will vary very little for stimulation of the nerve at different levels, except of course for the changes in latency.

In *neurapraxia*, which is a form of block to the impulse, stimulation above the lesion gives rise to no response, while below the lesion the nerve shows little or no change in the threshold of excitability or in the conduction velocity along it.

In *axonostenosis* the conduction velocity is reduced over the affected stretch of nerve. As this reduction is not the same for all the fibres involved, the latency for each motor unit differs. As a result, stimulation above the lesion gives rise to a response which is spread in time. If the axonostenosis is uncomplicated, stimulation below the level of the lesion with intensities within normal range should produce a compact response with a normal profile and latency.

Where *axonocachexia* complicates the situation, the reduction in conduction velocity is not limited to the site of compression, but applies to the whole distal stretch of nerve. Moreover, along the affected portion the threshold is grossly increased—indeed, some or all nerve fibres may appear refractory to every available and tolerable stimulus. Consequently, on stimulation above the site of the lesion a response exhibiting gross scatter is obtained after an abnormally long latency. Such response as may be obtained on forcible stimulation below the lesion also reveals signs of scatter, but with little or no resemblance to the other patterns.

With *axonotmesis* the picture is totally different, as responscs are not forthcoming and signs of frank denervation are in evidence in the shape of fibrillation potentials, and the intensity–duration curves obtained on direct stimulation of the muscles are those that characterize denervation.

It will be appreciated that two or more, or all, of these conditions may coexist, but that, whatever the complexity, supramaximal nerve stimulation at all levels above that of the lesion gives rise to substantially similar responses except for latency differences. Even when the nerve can be stimulated only above the lesion—as in compression of the median nerve in the carpal tunnel or the ulnar nerve in its palmar course—some idea as to the precise site can frequently be deduced from findings in well-conceived and methodical investigations.

To emphasize this point I should like to refer briefly to a case which presented with difficulty in picking up small objects without any sensory disturbances or marked wasting of the intrinsic muscles of the hand. Simultaneous electromyographic examination by means of needle electrodes in the adductor pollicis and in the third dorsal interosseus during stimulation of the

ulnar nerve at the wrist and elbow produced the records shown in Plate IX, Fig. 2. It will be seen that the patterns from the adductor pollicis show considerable scatter, while those of the third dorsal interosseus are compact. The scatter in the former is presumably due to the differential velocities along the nerve fibres distally to the point of stimulation. The fact that for both muscles the phenomena were substantially alike, except in respect of latencies, when stimulation was carried out at the wrist and at the elbow implied that the lesion was situated distally to both these points. On the other hand, the normal response obtained from the third dorsal interosseus as distinct from the temporarily dispersed one from the adductor pollicis made it fair to infer that the lesion was one of the ulnar nerve in the palmar section of its course after giving off a branch to the third dorsal interosseus.

It is interesting to note that if these electrical phenomena were fully rectified before being manifested, they would appear as a sort of histogram giving a graphic display approximately related to the number of nerve fibres responding at various intervals after stimulation. Whether this would convey more information than the raw material shown here is matter for conjecture.

I do not know at what juncture a series of mental notes, as distinct from chronicled observations, begin to suggest an underlying rule, but I have lately gathered the impression that the changes resulting from compression processes bear a definite relation to their position along the nerve—the more distally situated, the more marked or gross the departures from normal electrodiagnostic characteristics; conversely, the more proximal the lesion, the less the axonocachexia. What is more, lesions at two levels appear in some way to have an additive quality in their effects. This too is explainable by the fact that axoplasm has to be propelled along a small-bore tube from its source in the anterior horn to the periphery.

I should like to conclude by apologizing for the two neologisms which I have inflicted on you. My only excuse is that I am conscious that their use has vastly facilitated my task.

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PLATE IX

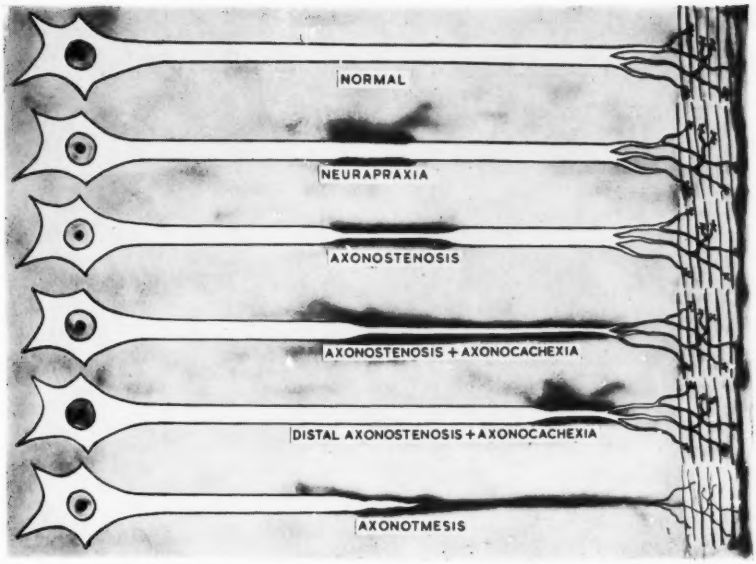


FIG. 1.—Diagrammatic representation of the various conditions which might arise in motor neurones composing a nerve as the result of progressive compression.

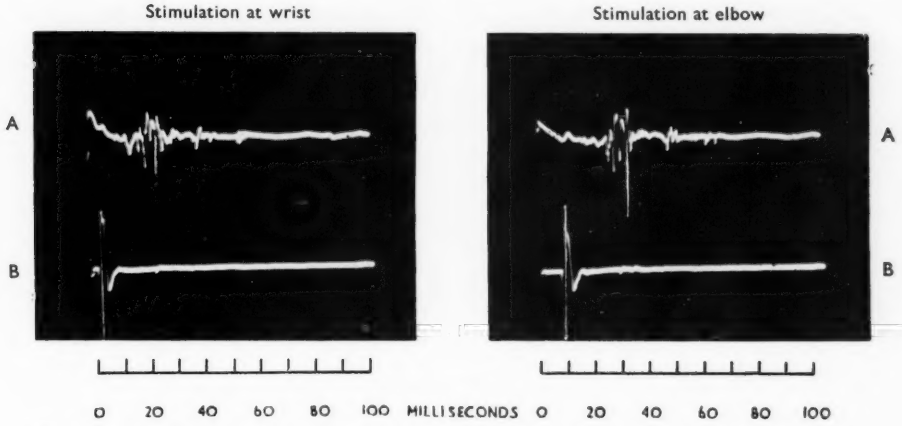
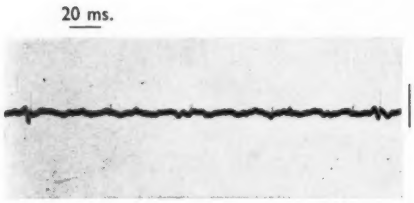


FIG. 2.—Simultaneous electromyographic recording from adductor pollicis (A) and third dorsal interosseus (B) during stimulation of the ulnar nerve at the wrist and the elbow, showing the scatter of the response in the former and the compact response in the latter muscle. The patterns of the responses are, however, substantially alike except for latency differences for stimulation at both levels.

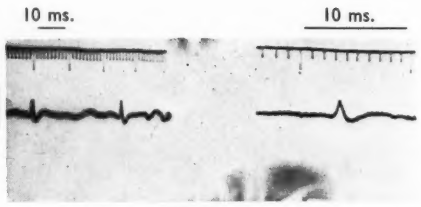
P.B. facing page 152]

PLATE X



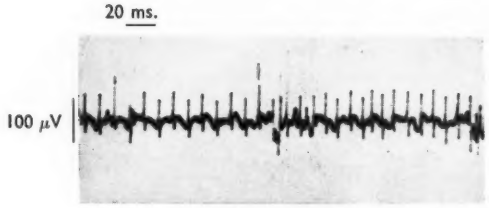
Fibrillation

FIG. 1



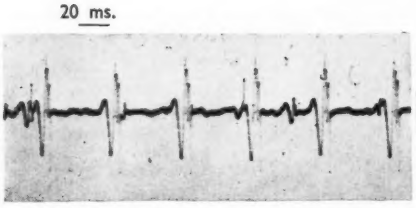
Fibrillation

FIG. 2



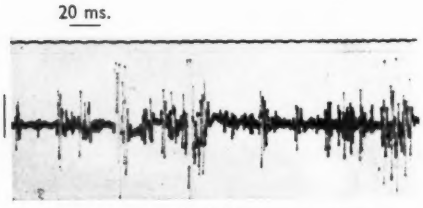
Myotonic run

FIG. 3



Complex units over 10 ms. of 7-8 phases

FIG. 4



Short-duration high-frequency pattern

FIG. 5

Representative electromyographic findings in cases of hyperkalaemic familial periodic paralysis.

J.B.M.

ORIGINAL PAPER

THE ELECTROMYOGRAPHIC CHANGES IN HYPERKALAEMIC FAMILIAL PERIODIC PARALYSIS*

By J. B. MORRISON

From Guy's Hospital, London

HYPERKALAEMIC familial periodic paralysis has been described by Gamstorp (1956, 1957), who termed it adynamia episodica hereditaria. As the name implies, it is a disease characterized by repeated attacks of flaccid paralysis, and which, like other forms of familial periodic paralysis, is associated with disorders of the serum potassium. Gamstorp observed that the paresis was the result of an increase in the serum potassium as opposed to the decreased level that is normally associated with hypokalaemic familial periodic paralysis. This raised level occurs without administration of potassium and without any change in the urinary excretion. Adrenocortical function remains unaltered. An oral dose of 1–2·5 g. of potassium in an affected patient may precipitate an attack of paralysis, whereas in a normal person 7–15 g. is required to produce transient muscle weakness; even then this will occur only in exceptional cases.

Clinically, the disease is manifested by spontaneous attacks of paralysis, which are sometimes preceded by acroparaesthesiae and may be precipitated by physical exertion followed by rest and lasting, on an average, for half an hour. Hunger, damp, and cold weather accentuate the attacks. The attacks usually start in childhood and affect mainly the limb and trunk muscles, the episodes occurring more often during the daytime. The disease is hereditary, and is thought to result from excessive ionic transfer of potassium from the cells into the intercellular spaces. On the electrocardiogram higher and sharper T waves accompany the increase in serum potassium. Muscle-biopsy findings are normal.

An increased motor response to acetylcholine has been found during and between attacks. Neuromuscular excitability was normal, and the velocity of propagation of an impulse was also within normal limits, both during and between attacks.

The following electromyographic findings were reported by Buchthal (1958):

Before Paresis.—Normal, apart from "ample spontaneous activity" in one case and brief spontaneous discharges in another.

During an Attack.—(*a*) "Irregular occurrence of spontaneous activity of

* Paper read at the Annual Meeting of the British Association of Physical Medicine, London, April 18, 1959.

apparent fibrillation, the muscles seemingly being at rest." The units were of short duration (2–4 milliseconds). (*b*) No increased frequency of polyphasic potentials (with more than four phases). (*c*) Mean duration of action potentials significantly below normal. (*d*) Reduced interference pattern on maximal volition.

Drager *et al.* (1958) described a condition which appears to be clinically similar and which they termed paramyotonia congenita. On electromyography their findings were as follows:

Before Paresis.—"Increased excitability characteristic of myotonia, found on penetration of the needle electrode."

During an Attack.—"Spontaneous activity of short-duration units (2 ms. or less) and units of moderate amplitude."

They noted a lack of response to faradic and galvanic stimulation in the anterior forearm muscles during an attack.

Ecker and Carson (1953) also described one case. They report that the electromyogram was normal, but it is not clear whether the patient in question was in an attack at the time of examination.

PRESENT INVESTIGATION

Five patients, members of the same family, suffering from hyperkalaemic familial periodic paralysis were subjected to electrodiagnostic investigation. There were three males and two females aged between 7 and 54 years. All had noted previous episodes of weakness, and were examined both in the active and the quiescent phases. Before an attack of paresis responses to galvanic and faradic stimulation of muscles were normal. During an attack the response to a galvanic stimulus was normal, but the response to faradism was reduced.

On electromyography the following findings were observed:

Before Paresis.—Normal.

During an Attack.—(*a*) Fibrillation (Plate X, Figs. 1 and 2) and spontaneous high-frequency "dive-bomber" myotonic runs (Fig. 3) were noted. (*b*) On volition, complex units of up to 7–8 phases with an amplitude of 250–300 microvolts and a duration of 10–12 ms. (Fig. 4) were found. (*c*) Also on volition were areas of high-frequency myopathic patterns of low amplitude, and of 2 ms. or less duration (Fig. 5). (*d*) On attempted maximal volition the interference pattern was reduced.

DISCUSSION

The electrodiagnostic changes accompanying hyperkalaemic familial periodic paralysis are characteristic and are quite unlike those found in periodic

paralysis associated with a low serum potassium level. The findings in the present series of five cases are largely in accord with those reported by Gamstorp, except that the spontaneous units found during an attack of paralysis were within the parameters of fibrillation. Furthermore, the complex units observed were more polyphasic.

The importance of the electromyographic changes will be apparent when the variation in serum potassium level is noted. Before paresis the patterns are normal, while during an attack the findings are those of a neuromuscular upset, which is in accord with the biochemistry of the disease. The electromyographic changes are always typical during an attack, and this enables the condition to be differentiated from hypokalaemic familial periodic paralysis.

SUMMARY

Hyperkalaemic familial periodic paralysis is characterized by repeated attacks of flaccid paralysis and, as the name implies, is associated with a high serum level of potassium. The clinical features are outlined.

The electrodiagnostic investigation of five patients in one family suffering from the disease is described. All showed typical electromyographic changes, which it is suggested should be of assistance in differential diagnosis.

ACKNOWLEDGMENTS

I would like to thank Dr. Brian McArdle for permission to investigate his cases and for his helpful advice throughout, and Dr. E. J. Crisp for his encouragement, useful suggestions, and criticism.

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ORIGINAL PAPER

ACCIDENTS IN A DEPARTMENT OF PHYSICAL MEDICINE*

By R. HARRIS

From the Devonshire Royal Hospital, Buxton

In any department where large numbers of frail and disabled people are treated accidents must be expected to happen. Many physical therapy departments are badly sited, badly planned, poorly lighted, understaffed, and overworked, and are fitted up with much potentially dangerous apparatus. As little has been published on the subject, it was thought worth while investigating the accidents that do occur in a large and busy physical medicine department.

In the two-year period before the investigation obvious defects in the department were corrected: for example, lighting and floor surfaces received attention, power points were made uniform, and unsuitable or rickety plinths were withdrawn from use.

An adequate fully trained staff was available in all departments during the period under review. Students and visiting therapists worked under supervision in the physiotherapy and occupational therapy departments—none of these were involved in accidents—and students in the hydrotherapy school were all qualified physiotherapists.

MATERIAL AND METHODS

All accidents and mishaps occurring in the physical therapy department, or to any patient being given physical treatment elsewhere in the hospital (e.g. bed exercises, ward dressing classes, outdoor walking exercises), or involving any patient preparing for, going to, or returning from physical treatment, including both in- and out-patients, were reported on a special proforma. This gave details of name, age, sex, diagnosis, accident and its cause, action taken, and staff eyewitness report. Staff accidents were similarly reported.

All accident reports in a four-year period were studied. The standard of reporting was high. The staff were aware of the investigation and were loyal and co-operative. There is good reason to believe that few accidents were not reported, and certainly no serious ones were omitted.

The hospital is mainly concerned with the treatment of in-patients with severe locomotor disease—representing probably one of the highest concentrations of seriously disabled patients in any hospital in the country receiving

* Paper read at the Annual Meeting of the British Association of Physical Medicine, London, April 18, 1959.

active physical treatment. The number of out-patients treated annually is roughly the same—around 1,000—but these receive about one-tenth of the number of treatments given to in-patients. Treatments were recorded on the M.O.H. system and amounted to approximately 200,000 per annum (physiotherapy, 150,000; hydrotherapy, 5,000; occupational therapy, 45,000).

RESULTS

Altogether 43 accidents were reported in the period studied, during which 800,000 treatments were given to a total of approximately 4,000 in-patients and 4,000 out-patients. Five of these accidents affected staff, seven affected out-patients, and thirty-one concerned in-patients. The accident/treatment ratio for patients is therefore less than 0·005%.

Staff Accidents

These differed considerably from patients' accidents and were as follows. (*a*) Laceration of hand: 2 minor cases. (*b*) Scald: 1 case. An orderly dropped a small instrument sterilizer of boiling water. This should have been emptied by a tap, but she was disobeying instructions to save time. (*c*) Falls from stool: 2 cases. (i) An orderly climbed on a stool to fix a curtain on its runner; the stool tipped over and she fell heavily. (ii) A physiotherapist climbed on a stool to adjust a sling suspension apparatus. The stool overturned and she fell, the stool leg catching her in the chest and breaking three ribs.

ACTIONS TAKEN

The stools involved have overhanging edges. These are being withdrawn from use and are being replaced by flush-edged stools. A pair of lightweight double steps has been issued to each treatment room. The sling suspension apparatus (which was one supplied by a well-known firm) was reviewed. It was found possible to reduce its over-all height by 14 inches without significant loss of function, and this has brought the frame top within the reach of all staff. All sling suspension frames have been shortened by 14 inches.

Patients' Accidents

There were 38 of these (males 16; females 22). The age range of the patients is given in Table I. Although the highest concentration is in the age group 59–69, the spread is otherwise uniform. Table II shows the conditions for which they were being treated. The proportion of neurological and hemiplegic patients involved is more than double their incidence in the hospital population. The apparently high incidence of accidents to "burns" patients is due to one such patient being involved in two accidents.

The accidents fell into four main groups. (*a*) Burns: 5 cases. (*b*) Falls or slips whilst walking: 9 cases. (*c*) Falls or slips from plinths, chairs, or apparatus: 17 cases. (*d*) Miscellaneous: 7 cases.

TABLE I

DISTRIBUTION OF PATIENTS ACCORDING TO AGE

	Age Group						
	20–29	30–39	40–49	50–59	60–69	70+	Total
No. of patients	6	3	7	7	13	2	38
Percentage	16	8	18	18	35	5	100

TABLE II

DISTRIBUTION OF PATIENTS ACCORDING TO DISEASE

Disease	No. of Patients	Percentage
Rheumatoid arthritis	18	47
Hemiplegia	4	10
Neurological disorder	5	13
Burns	3	8
Miscellaneous	8	22
Total	38	100

(*a*) BURNS (5 CASES) (TABLE III)

There were four short-wave burns and one ionization "burn". No burns occurred from faulty electrical equipment, heating lamps or cages, ultra-sound, or ultra-violet light.

One of the short-wave burns was due to faulty technique. A hemiplegic man aged 35, without sensory loss, had a linear second-degree burn of the thigh which took three weeks to heal. This was definitely a cable burn. The patient did not complain during treatment.

Two other subjects had small blisters. One "felt warm" during treatment. The current was switched off and the site inspected, but no abnormality was noted. Next day he had a 1-inch blister. Both these subjects were fully co-operative and had no sensory loss. Both were noted to be sweating heavily during treatment. The pad used measured $6\frac{1}{2} \times 10$ inches, and was applied over two thicknesses of lint and two felt spacers.

TABLE III

ANALYSIS OF CASES WITH BURNS

Case No.	Sex and Age		Diagnosis	Comment
1	M	22	Frozen shoulder	Sweat ++
2	M	60	Back strain	Sweat ++
3	M	35	Hemiplegia	Cable burn
4	M	70	Osteoarthritis of hips	Confused
5	F	64	Rheumatoid arthritis	Iontophoresis

The fourth burn occurred in a confused old man. The electrode used was $4\frac{1}{2} \times 7$ inches, and was applied over four felt spacers measuring 8×11 inches. The next day he was found to have a raw area $2 \times 2\frac{1}{2}$ inches at the treated site, but the appearance was really not that of a burn.

Perhaps it is significant that all these four short-wave burns were in men, who are probably less apt to complain than women.

The iontophoresis burn occurred under a wedding ring. Treatment had been ordered for the metacarpo-phalangeal joint of the ring finger, and the wedding ring could not be removed. The therapist took what seemed to be reasonable precautions, the ring being smeared with petroleum jelly and care taken that the electrode and fluid from it did not come in contact with the ring. The patient did not complain during treatment (2 mA for five minutes), but superficial blistering occurred under the ring.

TABLE IV

ACCIDENTS FROM FALLS OR SLIPS WHILST WALKING

Case No.	Sex and Age		Diagnosis	Supervision	Comment
6	F	60	Rheumatoid arthritis	Yes	Fracture of femur
7	F	60	Hemiplegia	Yes	
8	M	60	Rheumatoid arthritis	Yes	
9	F	35	Rheumatoid arthritis	Yes	
10	F	42	Hysteria	No	
11	F	41	Burns	Yes	
12	F	76	Fractured tibia	Yes	
13	F	60	Rheumatoid arthritis	Yes	
14	F	46	Rheumatoid arthritis	No	

(*b*) FALLS OR SLIPS WHILST WALKING (9 CASES) (TABLE IV)

All nine accidents in this category concerned women. Six minor accidents happened to unsupervised patients walking in the treatment departments or returning from them. Only one of these patients used crutches. The other three accidents happened when the patients were supervised: one during teaching of stair-climbing, one during a walking game, and the third during walking exercises. In the last instance a rheumatoid arthritic aged 60, grossly osteoporotic and with fixed knees, was standing at the bedside between an orderly and a physiotherapist when "her legs gave way" and she fell down. She was found to have a supracondylar fracture, which might well have been a stress fracture.

TABLE V

FALLS FROM PLINTHS, CHAIRS, OR WHEEL-CHAIRS

Case No.	Sex and Age		Diagnosis	Supervision	Comment
			i. FALLS FROM PLINTHS		
15	M	23	Friedreich's ataxia	Yes	Ataxic
16	F	62	Osteoarthritis of hips	Yes	Sitting up
17	M	51	Rheumatoid arthritis	No	Slip
18	F	20	Rheumatoid arthritis	No	Slip
19	F	48	Disseminated sclerosis	No	Turning
20	M	66	Hemiplegia	Yes	Confused—turning
			ii. FALLS FROM CHAIRS OR WHEEL-CHAIRS		
21	F	53	Rheumatoid arthritis	No	
22	F	45	Rheumatoid arthritis	No	
23	F	41	Rheumatoid arthritis	No	
24	M	32	Neurological disorder	Yes	
25	F	66	Rheumatoid arthritis	No	
26	F	63	Rheumatoid arthritis	Yes	
27	F	45	Rheumatoid arthritis	Yes	
28	F	51	Disseminated sclerosis	Yes	
29	M	57	Rheumatoid arthritis	Yes	Stool broke
30	F	51	Rheumatoid arthritis	Yes	Fall off stool
31	F	20	Poliomyelitis	Yes	Fall off stool

(*c*) FALLS FROM PLINTHS, CHAIRS, OR WHEEL-CHAIRS (17 CASES) (TABLE V)

There were six falls from plinths, none of which caused serious injury. Such accidents occurred when the patient was turning or moving on the plinth. The patients' ages ranged from 20 to 66; they were not grossly disabled, and

perhaps for this reason were inadequately supervised. Three of the six were neurological cases with co-ordination problems.

There were three minor accidents with chairs or stools. In one a stool leg gave way.

In the other eight accidents wheel-chairs were involved; six of these had extension leg pieces. Patients fell getting in or out of a chair. The usual fault was that the chair moved away owing to inadequate braking. Six of the patients were rheumatoid arthritics with multiple deformities; all were seriously disabled, but all injuries were trivial.

TABLE VI

MISCELLANEOUS INJURIES

Case No.	Sex and Age		Diagnosis	Comment
32	M	26	Burns	Pulled down apparatus
33	M	26	Burns	Saw-cut of hand
34	M	60	Hemiplegia	Collapse
35	M	59	Prolapsed intervertebral disk	Fainted during short-wave diathermy
36	M	45	Rheumatoid arthritis	Fracture of humerus: lifted
37	M	60	Ankylosing spondylitis	Injury to knee
38	F	50	Rheumatoid arthritis	Cut vein on stocking gadget

(*d*) MISCELLANEOUS GROUP (7 CASES) (TABLE VI)

This covered a wide variety of accidents. A "burns" patient pulled a net-ball stand on to him in a games class, and the same patient cut his hand on a saw in the workshop. A very osteoporotic, ankylosed rheumatoid arthritic sustained a fracture of the neck of the humerus when being lifted from a chair by staff.

The most bizarre accident happened to a rheumatoid patient with fixed knees who caught a stocking gadget in a varicose vein, breaking the atrophic skin and causing a dramatic haemorrhage.

ACTIONS TAKEN

Only in the burns group did technique appear to be at fault, and the danger of burns has now been brought home clearly to staff. It is difficult to see what additional precautions can be taken.

In regard to walking injuries, non-skid surfaces have been put in wherever possible. All heavily used passageways in the hospital have now been covered

with rubber flooring at a cost of over £3,500. All treatment-room floors have been given a non-skid finish.

All plinths have been checked. Where possible, low plinths are now in use; high plinths are used only when technique makes it necessary—e.g. massage. Apparatus and furniture have been reviewed, and a regular check is made. A more stable type of chair has been introduced. Existing chairs have been made safer by fixing rubber ferrules to the legs.

Wheel-chairs are the biggest problem, and one that is peculiar to this type of hospital, where over 100 wheel-chairs are in regular use. Old chairs have been withdrawn, and have been replaced with more stable, although more easily managed, chairs. Extension foot-pieces are not used unless essential. Chairs deteriorate rapidly unless kept in good condition and regularly overhauled by someone with mechanical knowledge. We have tried several systems: a male orderly was given responsibility for care and maintenance of chairs; the senior nursing staff then took this over; now the hospital engineering service have taken over and will be responsible for regular checks.

Using a different type of chair has brought new problems. For instance, the folding foot-piece of the type of chair introduced has a razor-sharp edge, and two patients have sustained lacerations of the legs in this way.

DISCUSSION

The value of this investigation lay mainly in that it showed to us unsuspected weaknesses in our departments and hospital, as we had eliminated suspected hazards before the investigation. Our patients are more seriously disabled than those found in a general hospital, and it is surprising that the accident rate is so low—physical treatment departments must be pretty safe places. Only three serious injuries, causing any disability or materially affecting the patient's progress for more than a few days, occurred—a cable burn and two fractures, one of which might have been spontaneous.

This study also provides some basic statistics. Wing and Watkins (1958) list four common groups of injury in physical therapy departments: (1) burns (short-wave diathermy, ultra-violet rays, heating apparatus); (2) electric shock; (3) injuries due to trips, falls, etc.; and (4) injuries from manipulations and therapeutic techniques.

We had no accidents from electric shock or therapeutic techniques. Our main fault appears to be inadequate supervision of patients.

It is unfortunate that we still have to rely on the patient's sensation when giving short-wave diathermy. Our findings show how unreliable this can be.

Acknowledgments and Reference appear at foot of p. 167

ORIGINAL PAPER

ARTHRITIS IN ANIMALS

A SHORT SURVEY OF SOME OF THE LITERATURE

By J. EUAN DAWSON

Droitwich

"Our old grouchy friend who would not lie down, Lizzie, the elephant, that lived here for 38 years, got so sore a foot that she slipped and broke her leg. Chronic arthritis is well known for these big animals, and when one will not take the weight off her feet the arthritis will not get better nor can she expect to be nimble when she gets a sore toe." In these words Fox (1923) recounts the misfortunes of a zoo elephant. He goes on to describe the constant attention which is devoted to the feet of elephants in captivity throughout the world. The picture which he draws does not seem to differ greatly from that of the countless two-legged Lizzies who are met in the daily work of physical medicine departments. It was thought, therefore, that it was worth reviewing briefly some of the work published on this "joint burden laid upon us all", animals and man alike, and in particular that concerning zoo animals.

Arthritis is probably the most ancient of known diseases, having existed almost since vertebrate life began. Moody (1923) says it may be 600 million years old. The pathology of degenerative joint disease has been essentially the same for 100 million years. In the museum of the University of Kansas is a skeleton of a mosasaur called *Platecarpus* (Plate XI, Fig. 1), which was a swimming reptile; the metatarsals show broadening and roughening at the articular margins. At Drumheller, Alberta, a dinosaur skeleton was dug up which shows anomalies, if not obvious arthritic changes, in the caudal joints (Plate XI, Fig. 2).

The story continues through the ages, specimens having been found in the Eocene (70–50 million years), the Miocene (35–15 million years), and the Pleistocene (1,000,000–500,000 years). In the Pleistocene period the sabre-toothed cat (*Smilodon*) found in the asphalt beds of California and the cave bear (*Ursus spelacus*) of Europe are examples of prehistoric animals showing osteophytosis in the dorsal vertebrae (Plate XI, Fig. 3). There is also the tumour mass between the caudal vertebrae of a dinosaur displayed in the Wellcome Museum in London (Plate XI, Fig. 4).

So much for prehistory. What of the present?

For the purposes of this short paper animals can be conveniently divided

into domestic and wild animals, and the wild animals further subdivided into those which are truly wild and those in captivity.

DOMESTIC ANIMALS

Arthritis in domestic animals has been dealt with widely from many aspects. One of the earliest treatises is by Bracken, who in the middle of the eighteenth century advised counter-irritation for ischiatica or the hip gout of horses. Though modern electrical methods of applying heat or counter-irritation may be more refined, the results may not differ greatly from those of the insertion of red-hot needles or the explosive fire of moxa. Moxa was used in China in ancient times and consisted of a small cone of a combustible material which was applied to the skin and then ignited. In a book of the early nineteenth century Bath and Buxton are suggested as suitable spas for rheumatic horses!

WILD ANIMALS

Truly Wild Animals

The chances of investigating joint conditions in truly wild animals have been relatively poor, owing to the natural reluctance on the part of the patient to submit to examination and subsequent follow-up. The literature is scanty, but Fox tells of a hippopotamus, shot in the wild, which showed marked osteoarthritis in the sacro-iliac and lumbar joints.

Cross (1940) cites two timber wolves, the first of which was caught in a wolf snare. This animal was in good condition; its muscles were healthy, but heavy bone deposits were found on the lateral epicondyle and olecranon fossa of the right humerus and the proximal articular surface of the right ulna. The author observes that movement of the joint must have been impeded and was probably painful. The left hind leg was in a worse condition, with heavy deposits of bone around the distal articular surface of the femur. There was a little lipping of the vertebrae. The only sign of trauma was an old fracture of one of the ribs. The other timber wolf, shot in the wild, showed slight lipping at all limb joints. The only extensive changes were in the hind feet, where there were marked degenerative and destructive changes in some of the tarso-metatarsal joints and in the interphalangeal joints. The cervical spine showed lipping, which became progressively worse down to D 7, where it ended abruptly. There was little lipping in the lumbar joints, but heavy bone deposits were present along the sacrococcygeal joint, the sacrum having been fractured at some time, and there were several other old fractures. The author comments that such conditions were characteristic of osteoarthritis, and that most students of this form of arthritis regard it as essentially a degenerative process, predisposing factors being age and trauma.

PLATE XI

FIG. 1.—Multiple arthritis in (*a*) metatarsals of a Kansas Cretaceous mosasaur; (*b*) terminal phalanges of big toe of mosasaur, *Platecarpus*; (*c*) phalanges of mosasaur. (From Roy L. Moodie, *Paleopathology*, pl. xli, facing p. 216; Urbana, Illinois.)

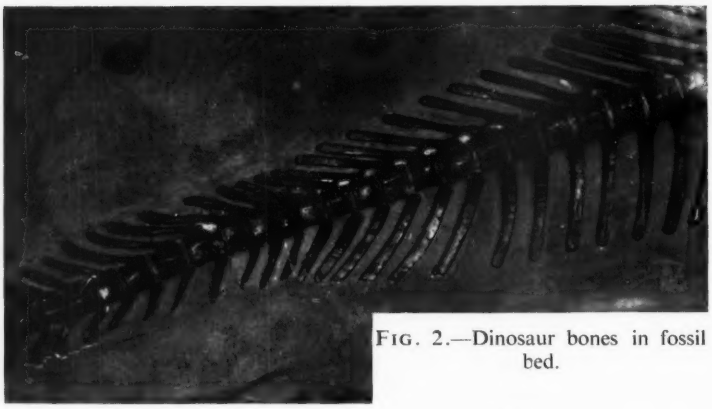

FIG. 2.—Dinosaur bones in fossil bed.

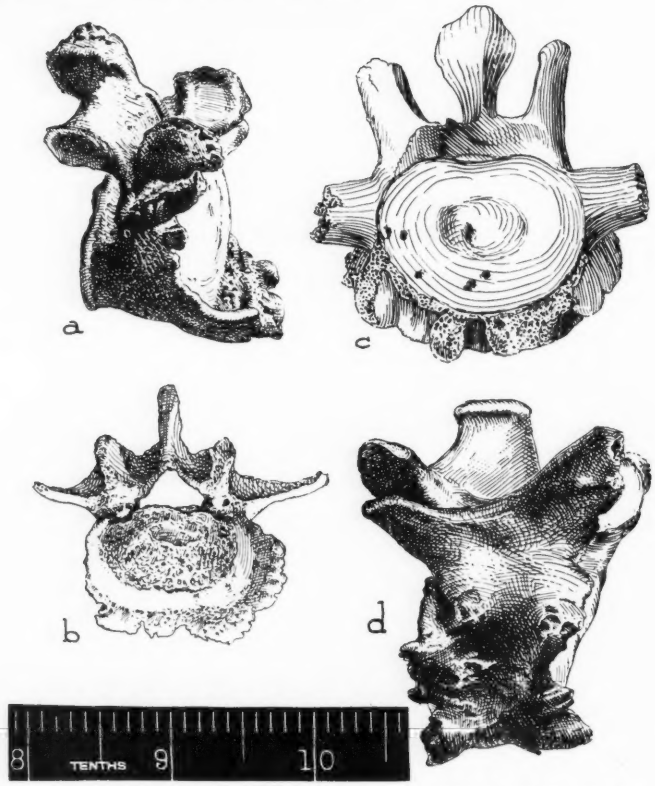

FIG. 3.—Spondylitis deformans in (*a*) recent human lumbar vertebra; (*b*) lumbar vertebra of ancient Egyptian; (*c*) dorsal vertebra of cave-bear; (*d*) dorsal vertebra of sabre-toothed cat. (From Roy L. Moodie, *Paleopathology*, pl. xliii, facing p. 220; Urbana, Illinois.)

FIG. 4.—Tumour mass (possibly a haemangioma) affecting two caudal vertebrae of a dinosaur, *Apatosaurus louisae* Holland. Como Beds, Comanchean (Lower Cretacious), of Wyoming. (In the Wellcome Historical Medical Museum. Museum No. R729/1939.)

FIG. 5.—Alligator's heart showing urate deposits on pericardium.

FIG. 6.—Limb joints of radiated tortoise showing urate deposits.

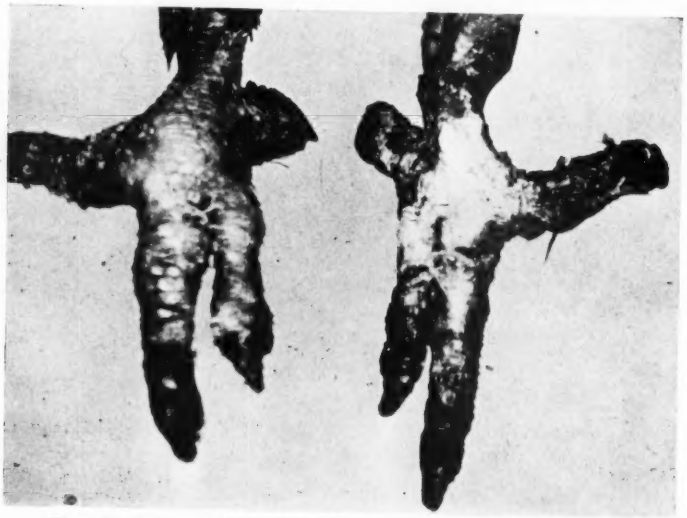

FIG. 7.—Feet of ring-necked parrakeet showing urate deposits.

Animals in Captivity

The study of bone and joint conditions in zoo animals is apparently also a very difficult subject, and up-to-date literature is scanty.

Some 35 years ago Fox analysed over 1,700 skeletons of zoo animals and found joint changes corresponding with what he described as chronic arthritis in man. Out of 1,749 skeletons, 77 were found to have arthritis, mostly in the spinal column, but also in the appendicular skeleton. The disease occurred most commonly in anthropoid apes and baboons, cats, hyenas, bears, bovines, deer, moose, and elk; dogs, wolves, foxes, and small animals such as mice and rats were relatively free. Thus animals most often affected with arthritis were macrosomic, and small-bodied animals were more rarely and less severely affected. Fox thought that the distribution in different species of animals suggested a relationship between function and localization of disease, possibly involving locomotion. He suggested that a hypertrophic and periarticular type of disease was more prominent in carnivorous animals as contrasted with an osteoporotic and ulcerative type which was seen more frequently in herbivorous animals, and as examples he cited hyenas and gorillas. He found that carnivora had more serious arthritis in the fore limbs and almost none in the hind limbs, possibly because most carnivora pounce on their prey and hold it while they rend it with their teeth. Artiodactyla—ungulate mammals including sheep, deer, giraffes, camels, hippopotamuses, and pigs—have more conspicuous lesions in the hind limb, although the fore-limb joints may also be diseased.

Lesions of hand and foot are more common in animals in which there is greater specialization of evolution and function. It is notable also, but perhaps not surprising, that the most conspicuous arthritics are heavy, and that many have slender supports or legs which appear too small for the body—for instance, gorillas, bovines, and the like.

Among the many cases which Fox quotes are some of particular interest: cervical, thoracic, and lumbar arthritis in kangaroos and wallabies; lipping of the eighth, ninth, and tenth thoracic vertebrae in a giraffe. Two wart-hogs had severe bilateral osteoarthritis of the hips with mushrooming of both femoral heads; one of them had in addition osteoarthritis of the left humero-ulnar joint with so much overgrowth that the bones could not be separated. A sambur deer had bilateral valgus deformities of the "fore-knees" and partial subluxation of the joints. A goat antelope had osteoarthritis of the lower cervical and upper dorsal spines, shoulders, and hips; the contours of the humeral head showed a bilateral upward dislocation, one head having marked hypertrophic change. A sea-lion had osteoarthritis in the pelvis and left femoral head, and an elk showed a chronic bursitis, an inflammatory condition of the articular carti-

lage with oedema of the periarticular tissues. Leopards, a lion, and a tiger all showed degenerative changes in the spine or scapulo-humeral joints and also in the radio-carpal and elbow joints. A mandrill showed an extensive scoliosis with no fewer than six distinct curvatures throughout the spine; and a gorilla, changes in the joints of the hands suggestive of a rheumatoid type of arthritis. Also described is a white-nosed coati with generalized tuberculosis which also involved the wrist-joint, where there was a carious and ulcerative arthritis.

THE ELEPHANT

It has been said that "the elephant hath joints but none for courtesy", that his legs are legs for necessity and not for flexure, and again Fox gives us examples. One elephant, which was born wild but died in captivity, at post-mortem examination was found to have a chronic myocarditis with chronic pulmonary tuberculosis; the joints were swollen, the distal end of the right femur was ulcerated, and all the tarsal joints were irregular. Another elephant, described as having obvious discomfort and stiffness in the left fore-leg and shoulder, was treated with aspirin and soda—how much we are not told—and Carlsbad salts, which are said to be detergent and antacid. "Whether," the author comments, "this treatment had any direct action or whether she would have improved without it, she is better after three days of its use."

REPTILES AND BIRDS

Reptiles do not escape the scourge of arthritis and skeletal deformity. Fox in another publication reports a painted tortoise (*Terrapene ornata*) whose shell showed a hump on the left side, forward of the middle. This proved to be a kypho-scoliosis of all the vertebrae within the shell, the vertebral bodies being twisted to face the right. There was no apparent necrosis of any of the vertebrae, and both shoulder and pelvic girdles seemed to be symmetrical.

Reptiles and birds suffer from a form of gout in which urates are deposited in the pericardium, the serous surface of the liver and other viscera, and also in the joint capsule (Plate XI, Figs. 5 and 6). The condition is often associated with urate deposits in the ureters and kidneys and is ascribed to excess protein or water imbalance. It appears to be found particularly in birds of prey.

In birds a condition analogous to gouty arthritis appears usually in the pedal joints, but it may also be found in the wings. Swellings occur which may be irregular, and are apparently tender judging by the reaction of the bird to pressure on them. Often these swellings arise on the flexor or plantar surface of the toes or in the tarsal joints (Plate XI, Fig. 7).

The examples cited above may serve to show the wide incidence of arthritic conditions throughout the animal world from time immemorial. From this it would appear that man's place and affliction are merely coincidental.

ACKNOWLEDGMENTS

I have much pleasure in thanking Dr. Ashworth Underwood, Director of the Wellcome Historical Medical Museum, for his kindness and permission to use the photographs reproduced in Figs. 1, 3, and 4; Dr. K. W. Head, of the Royal (Dick) School of Veterinary Studies, Edinburgh, for his help; and Dr. E. C. Appleby, of the Royal Zoological Society of Scotland, who has allowed me to reproduce the photographs in Figs. 5–7.

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HARRIS: ACCIDENTS IN A DEPARTMENT OF PHYSICAL MEDICINE,
concluded from p. 162

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I wish to thank all members of the staff of the hospital who co-operated in this investigation—nurses, physiotherapists, occupational therapists, hydrotherapists, and orderlies—and the hospital administration and house committee for their help.

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CLINICAL REPORT

TWO CASES OF NECK PAIN PRESENTING DIFFICULTY IN DIAGNOSIS

By I. WILLIAMS

From the Middlesex Hospital, London

THE following cases were first seen in the out-patient department of the Middlesex Hospital, and serve to illustrate that, while cervical disk lesions and degenerative changes in the cervical spine are the commonest causes of neck pain, other conditions may occur, often when least suspected or suggested by the clinical findings.

CASE 1

In May, 1958, a Cypriot woman aged 54 was brought to the out-patient department complaining of a severe pain in the occipital region. She had had an attack of vomiting five weeks previously, after a somewhat heavy meal, and had suddenly experienced a severe pain in the nape of her neck which radiated into the occiput and to both sides of the face. Since that time the pain had been more or less continuous, gradually becoming more severe and disturbing her sleep; it was aggravated by neck movements and the effort of straining. She had not noticed pain in the arm or shoulder, paraesthesiae, or muscle weakness. She stated that she had lost one stone in weight recently, but apart from anorexia had no other symptoms. She was known to have had diabetes for 16 years, and, while this had been treated by diet, she had developed early cataract and a mild peripheral neuritis.

She was admitted to hospital, and on examination she appeared ill, was dehydrated and anaemic, and had a very stiff cervical spine, all movements being resisted because they caused pain. Apart from slight weakness and wasting of the right thenar muscles there were no other abnormal signs in the central nervous system, though her reflexes were sluggish. She had a low-grade fever, and it was noted that the posterior wall of the pharynx was dry and reddened. Her haemoglobin was 59% (Haldane) and her blood urea 158 mg. per 100 ml. The blood-sugar level was normal and there was no sugar or acetone in the urine, but albumin and numerous *Escherichia coli* were present with a moderate number of white and red blood cells. Radiographs of the cervical spine showed some narrowing of the lower cervical disks and a large soft-tissue swelling on the posterior pharyngeal wall (Plate XII, Fig. 1). This was diagnosed as a retropharyngeal abscess, and a further examination of her pharynx by an E.N.T. surgeon revealed a palpable tender swelling here. This was incised under local anaesthesia, releasing a large quantity of pus which on culture grew *E. coli* sensitive to the broad-spectrum antibiotics. The patient was treated with intravenous fluids, including 2 pints of blood, and with tetracycline in full dosage, and apparently made a slow but satisfactory recovery.

However, she was readmitted to hospital in August, 1958, with a recurrence of the neck pain. Routine radiographs showed no significant abnormality, but lateral tomograms revealed erosion of the odontoid peg and subluxation of the odontoid peg backwards. While being assisted on to a commode she fell to the floor and was unable

FIG. 1.—Case 1. Lateral radiograph of cervical spine showing large soft-tissue swelling in front of the vertebral bodies.

FIG. 2.—Case 2. Tomograph showing lesion at apex of right lung.

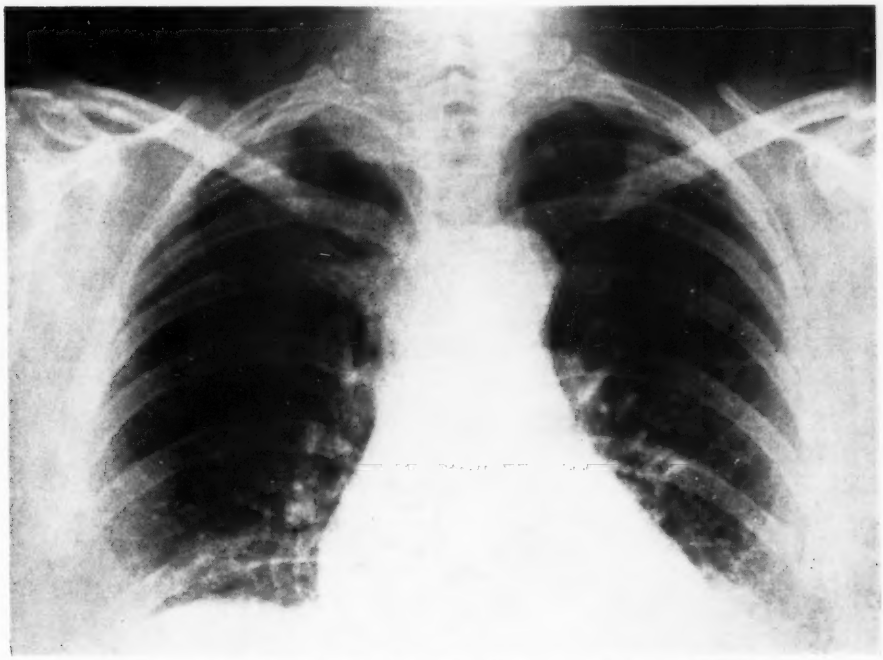

FIG. 3.—Case 2. Radiograph of chest showing opacity at apex of right lung.

to move her legs. Plantar extensor responses were elicited, and she had developed a widespread "peripheral neuropathy" with flaccid weakness of the forearms and legs, grossly diminished reflexes, and loss of postural and vibration sense in the legs. It was evident that the cervical cord was compressed, and she was immobilized on a plaster bed and treated with streptomycin and isoniazid. However, bed sores, vomiting, and mental confusion developed, and she died suddenly in October, 1958.

At post-mortem examination she was found to have an osteomyelitis of the upper cervical vertebrae, with subluxation and backward tilting of the odontoid peg; the upper cervical cord was compressed by extradural granulation tissue. Non-specific inflammatory changes were seen on microscopic section, and cultures for tubercle bacilli were negative. The kidneys were affected by a chronic pyelonephritis.

CASE 2

The second patient, a woman of 53, had symptoms of a much more chronic nature. She was first seen in September, 1957, with a two-year history of an inconstant mild pain at the back of the neck which radiated into the head and right shoulder; she had no pain, paraesthesiae, or motor weakness in her arms. On examination she had an almost full range of neck movements with some pain on rotation and lateral flexion of the head to the right, and tenderness was elicited on palpation over the lower cervical spinous processes and right paracervical muscles. Radiographs of the cervical spine revealed minor degenerative changes consistent with her age. Because of some disparity between her symptoms and signs, and because she was of a somewhat introspective nature, her condition was thought to be functional rather than organic and she was given symptomatic physiotherapy.

By December, 1957, the pain had become severe, and the patient had in fact visited an osteopath, who manipulated her neck on several occasions, which served only to increase the pain. She then developed an acute respiratory infection accompanied by fever, haemoptysis, and loss of weight. Her erythrocyte sedimentation rate was found to be high, and radiographs of the chest, including tomograms, revealed a lesion at the apex of the right lung (Plate XII, Figs. 2 and 3).

In view of these rather ominous symptoms and signs she was admitted to hospital and a thoracotomy with resection of the lesion was performed. On pathological examination the lesion was found to be an area of fibrosis resulting from previous tuberculous infection. The patient made an uneventful recovery, and soon after the operation said that she had full, painless movement of her neck for the first time for many months.

COMMENT

In this second case the diagnosis was, and in fact could only be, made with certainty by resecting the lesion and examining it under a microscope. The case is not only interesting as presenting an unusual cause for neck pain, but also salutary in showing that apical tuberculosis can mimic a Pancoast tumour.

ACKNOWLEDGMENTS

I should like to thank Dr. A. C. Boyle for his permission to publish Case 2, and Dr. S. Mattingly for his valuable help with Case 1.

REVIEW SERIES

REHABILITATION OF THE ELDERLY PATIENT

By MARJORY W. WARREN, C.B.E.

From the Geriatric Unit, West Middlesex Hospital, Isleworth, Middlesex

THE rehabilitation of elderly patients is an essential part of medicine to-day, and the subject is very comprehensive with far-reaching implications. It is important from a sociological and economic point of view, and interesting from a medical point of view, but difficult to practise well. With an ageing population and a larger number of older persons who present themselves for a medical opinion and/or treatment, the subject impinges upon all branches of medicine and invades every field of medical practice. Whether the patient visits his general practitioner, enters hospital, or consults a specialist, it is necessary that his medical adviser should know something of the conditions likely to occur in a sick elderly person; that he should be able to prevent deterioration as often and as effectively as possible; and that he should know what active methods of approach and treatment to apply.

At present, apart from those working in a geriatric service, far too little is known of the conditions liable to affect old persons and of the results likely to follow disability or illness, physical or mental. There is also insufficient knowledge of the common effects of social conditions upon the physical and/or mental state of an elderly person. Little regular instruction in the subject is given to medical students or to postgraduates in medicine, and as a result the challenge of good care of elderly patients is often too difficult to meet.

PREVENTION OF INVALIDISM

Rehabilitation, which is a comprehensive subject including an approach to and an attitude of mind to disabilities, must be considered in the care of *every* old person—whether he be a reasonably fit old person with some quite minor illness under treatment by his family doctor at home, or one who is acutely ill with a medical or a surgical diagnosis in a hospital; whether he has met with an accident, or is an old person with an irremediable or long-term illness (previously referred to as chronic) at home or in hospital. Rehabilitation must be available to every old person who needs it and can benefit from it if the elderly, as a group, are to remain as independent and as active as circumstances allow.

A programme of rehabilitation can be successful only when it is undertaken by a therapeutic team including medical and nursing personnel, trained social

workers, and such ancillary staff (physiotherapists, occupational therapists, speech therapists, etc.) as can make a constructive contribution to recovery or improvement. In such a team every member must not only be competent to practise his own special work, but must also understand something of the work and role of the other members of the team. By this understanding he will also appreciate his own place in the team and the way in which he must consult with and advise others in working for the patient.

The elderly, more than any other group of patients except perhaps children, need a very personal approach, and this is why continuity of treatment is so important. The old, when sick, appreciate their insecurity, and are inclined to lose morale quickly and become depressed and/or apathetic. Such a mood is quite unsuitable for successful rehabilitation, and therefore it is essential to make an approach to, and contact with, the patient which will give him confidence and improve his morale, for without this, prevention and active therapy will fail. The importance of great interest in, and a good personal contact with, elderly patients during treatment and rehabilitation cannot be emphasized too much or repeated too often.

With the old it is often the presence of multiple pathology which makes it difficult to treat the patient adequately. For example, an elderly patient admitted with a coronary episode and degenerative joint disease may during his inactivity need passive movements of his joints. If this treatment is overlooked, then when he is fit again to become active he may be severely disabled by stiff joints and as a result need a long course of rehabilitation. During this prolonged period his social conditions may worsen, making his independence for the future uncertain. Only with the knowledge of the consequences of lack of prevention or under-treatment can such disasters be avoided.

RESULTS OF LACK OF PREVENTION

As in all fields of medicine, prevention offers the best approach to the patient, and without this elderly patients deteriorate rapidly and seriously. Often those with the best intentions but without appropriate knowledge undermine the independence of the ageing person, not only by suggesting but by insisting that he relinquish duties and responsibilities which he could well continue. Such an approach is likely to reduce the elderly person's morale by suggesting that he is failing, and must therefore become dependent on another for things which he hitherto undertook satisfactorily for himself. In the early days he may enjoy the extra attention, and the relative or friend, or the nurse in hospital, may gain satisfaction from giving this help—even though it is not really necessary. As time wears on, however, he begins to feel a burden, and the friend

may not conceal the fact that he finds the additional help which has become essential to be an unwelcome addition to his own work.

Slightly depressed and by now a definite responsibility upon others, the old person begins to lose the desire to remain independent and gradually relinquishes one thing after another, placing the responsibilities upon others. At first such help relates usually to duties outside the home, but it may soon come to pass that he does nothing for himself inside the home, and he rapidly becomes dependent upon others even for his personal needs. At this stage relations and friends begin to find the extra care needed too much for them; and as less help becomes available the old person may even be encouraged to stay in bed as an easy way out of his difficulties. Once this becomes established then a known sequence of events can be anticipated.

A bed-fast patient, liable to feel the cold, keeps warm by remaining under the bedclothes, and this leads to stiffness of the joints, especially the shoulders, hips, and knees. If he keeps to his bed he tends to become less and less interested in people and his surroundings, so that he sleeps a good deal in the daytime, and this spoils his chances of an uninterrupted night's sleep. Sleeplessness at night, when reported, is liable to be corrected by sedatives, which tend to confuse the patient and he drinks less well than he should, becoming as a result a little uraemic and often more confused. This in turn frequently leads to incontinence and all the medical and social troubles which ensue. Such a sequence of events is very common indeed and occurs with frightening ease and speed. When such conditions are established, unless his social circumstances are very good the patient will need admission to hospital, despite the fact that, from a medical point of view, he has no specific disease. He has now become—has, in fact, been made—dependent upon others, an unnecessary burden to the community, and a difficult medical problem for rehabilitation.

Such a situation, which can and does arise so easily with no pathological basis other than a general slowing of physical and mental processes, occurs even more rapidly when signs of disease are present—often untreated and generally unnoticed. Common conditions giving rise to such sequelae are cardiovascular disease, minimal cerebrovascular accident with hemiparesis, Parkinson's disease, cerebral atherosclerosis, arthritis, and the anaemias, including macrocytic anaemia.

When such patients are admitted to hospital, as indeed they must be in the majority of cases, it is the preventable sequelae of bedfastness that are difficult to treat, rather than the basic condition—and that is why prevention is so important. While such conditions may occur at home even when the family doctor is in attendance, many more patients become bedfast and/or dependent for personal needs while in hospital for treatment of, for instance, a chest or

heart affection, gangrene of one lower extremity, after an accident, or undergoing a surgical operation.

Before discussing other aspects of rehabilitation it is necessary to consider ways in which such preventable conditions can be avoided both at home and while in the general wards of hospitals.

GENERAL PRINCIPLES OF PREVENTION

The vast majority of old people are capable of attending to their personal needs. In so doing they maintain interest in themselves—for example, attention to hair, a decision about dress—and have the psychological satisfaction of remaining independent. Attention to personal needs provides excellent physiotherapy and occupational therapy, exercising trunk and limbs, and also keeping the mind active. Psychologically, morale is maintained so long as the individual can decide, with interest, at what time and in what manner his personal needs will be undertaken.

Every patient under treatment for a physical or mental disability needs active prevention, together with a full and active rehabilitation programme, if *all* conditions are to be cared for as well as the specific or main condition.

With these principles in mind it is obvious that whenever possible an elderly patient should remain up and not be confined to bed. When an elderly patient is under treatment in bed the question should be asked, Why can this patient not get up? If it is not advisable for the patient to sit out of bed, then he can usually be nursed *on* his bed instead of tucked up in it. Such patients should wear a dressing-gown back to front, with socks and leather lace-up walking shoes. Worn in this way the dressing-gown will not be soiled by the incontinent patient, it will be much more easy to put on by relatives or nurses, and the patient will be tidy and warm. The shoes, being laced up, will not easily come off, and will keep the feet protected, warm, and in good position. Such treatment will prevent malpositions, help to keep the patient interested and alert to his surroundings, and so preserve morale. Throughout treatment patients must be encouraged to do as much for themselves as possible in attending to personal needs, and also undertake some diversional occupational therapy. In short, whenever the patient is unable to do something which normally he would do, then conditions should be examined in an attempt to find a way by adaptation.

By adopting such simple methods as are outlined above much additional invalidism can be avoided. This aspect of prevention is as important as active treatment. Indeed, without good prevention much active work will fail, and a patient who should remain independent and be able to return to the community may, and often does, become a permanent hospital responsibility.

ACTIVE TREATMENT AND RETRAINING

Throughout active rehabilitation programmes, methods of prevention must be practised concurrently. It is not possible to describe the detailed procedures to be used with every patient who needs rehabilitation, but general principles can be adopted and adapted as necessary.

Whenever an elderly patient is under treatment, it is important to consider, in addition to the medical condition, the *social* conditions, as these are important in planning for the future. For example, if a patient must return to his home where there are stairs, then it is necessary to see that he can manage stairs before being discharged; and if he is to live alone he must be as competent as possible and quite confident about his safety—and his social conditions must be prepared for him. All the pathology present must be considered, as each separate factor plays a part in making the programme of rehabilitation. For example, a blind hemiplegic will need special attention to his blindness in addition to that needed for his hemiplegia; and a deaf hemiplegic may be more difficult to train in walking because, not hearing instructions, he will co-operate less well. A double amputee in cardiac failure will need very careful consideration of his tolerance to exercise; and a mentally frail patient will not respond so easily to instructions in exercises for his arthritis.

Independence for personal needs must always be aimed at, and achieved whenever possible. Every necessary help, adaptation, aid, or equipment must be used to overcome the patient's handicap(s). The use of high beds in hospital is responsible for many patients becoming unnecessarily dependent and unsafe, and a number of accidents also occur. Such accidents are not infrequently followed by the use of cot sides; these are often unnecessary, and an added source of irritation to the patient, who now feels restrained.

Aids

While training a patient to become independent again for personal needs he must have exercise with an object and of a kind which is acceptable. The patient will be encouraged to find that he can wash his face, brush his teeth and hair, and perhaps shave with an electric razor. Whenever necessary the patient should be supplied with suitable gadgets so that he can remain independent. For example, the hemiplegic should use a Nelson combined knife and fork,* so that he can cut up his food and feed himself easily; an arthritic should have the handles of his knife, fork, and spoon built up to suit his grip. With certain disabilities clothes must be adapted to facilitate efficient and easy dressing—for example, shoes with zip fasteners instead of laces for the hemiplegic and loose-fitting clothes for an arthritic. A portable urinal for a man or a plastic petticoat

* Nelson knife designed by Queen Mary's Hospital, Roehampton, London, S.W.15.

worn over the knickers for a woman saves much worry, and helps to preserve morale, in the case of incontinence. For women, court shoes and high heels are most unsuitable, and lace-up shoes are better than strap shoes as they support the foot better, stay on more reliably, and limit oedema when present, so that the tarsal joints remain free. It is important that all aids—glasses, hearing aids, callipers, pylons, prostheses, etc.—are provided and worn during periods of rehabilitation.

Walking Training*

With most patients undergoing rehabilitation the aim is full ambulation, and the programme of treatment is divided into the following phases:

Phase 1: Exercise in Bed.—Usually for only a few days during an initial assessment.

Phase 2: Exercise on the Bed.—This period varies in length according to the patient's condition and disability. During this time limbs may be suspended in fixed slings or in springs and slings, according to the type of movement aimed at. In fixed slings movement of upper and/or lower limbs is possible in a horizontal plane; in springs a wider range of movements is obtainable, including raising and lowering the limb, flexion and extension, adduction and abduction; with a combination of fixed slings and of slings and springs a still greater variety of movement can be obtained. In some cases total suspension improves not only the physical but also the psychological condition of the patient, and generally loosens up stiff joints and relaxes a tense and worried personality. While on the bed the patient should be given some instruction in trying to sit up from the prone position, as this exercises the anterior abdominal muscles and improves trunk control.

Phase 3: Exercise at the Bed-end.—This has become a standard pattern of training to follow exercise *on* the bed. As soon as a patient is fit to sit out of bed in a chair he can sit at the foot of his bed with his feet resting against a bed-end board placed on the floor across the foot of the bed. (Bed-end boards should measure 4 feet in width and 4 by 2 inches on section.) The patient should sit in an arm-chair suited to his disability—that is, of correct height and material. The height of the chair should ensure that when the patient is sitting well back in the seat his trunk, thighs, legs, and feet will be at right-angles to each other. In this position he sits upright, his feet cannot slip, and he can hold with one or both hands the rail at the foot of the bed. During this period, and in the position described above, the patient learns to raise himself into an erect position, and to sit down again slowly and correctly, unaided. A chair with a firm seat is easier for him at this stage than one with a soft seat.

* "Retraining the Elderly Hemiplegic", *Geriatrics*, 1953, **8**, 198.

Throughout his rehabilitation the patient is encouraged to lean and put weight on to inanimate objects—rails, sticks, etc.—and the therapist, who may be doctor or nurse, physiotherapist or occupational therapist, is instructed to give as little supporting help as possible. The principle of not leaning on people is important because so long as the patient is supported by a therapist he gains no confidence in himself and it is impossible to assess his tolerance to exercise. Until he can stand and sit without help he is not ready to proceed further. When he *can* do this, then he should be encouraged to raise first one and then the other foot off the ground, and finally to walk sideways across the end of his bed—always using the bed-end board as a foot-stop.

*Phase 4: At the Rail.**—Rails should be made of wood 2 inches in diameter, placed 3 feet above the floor or stair level and set 2 or 3 inches from the wall. When the patient can walk sideways across the end of his bed, then he is ready to walk forwards without a foot-stop and holding on to the rail. It is advisable to train the patient in a definite pattern of gait at the rail as follows:

(*a*) Hand forward on the rail—and later on the stick.

(*b*) The hemiplegic should lead with the paresed foot and follow with the sound foot. The single amputee should lead with the sound foot and follow with the pylon. The patient with a fractured hip or the arthritic may lead with either foot.

(*c*) Pause. This pause is important, as it gives the necessary time to correct the position before placing the hand well forward again.

This is called a "split" gait, as it breaks the normal gait into its component parts.

During this phase of treatment the therapist should walk sideways very close to, but not holding, the patient until he has gained sufficient confidence to walk unsupervised. In this position the therapist can observe the patient well, can give him his entire attention, and support him easily and quickly should he tend to fall.

Phase 5.—When it is safe for him to go alone while holding the rail he should be taught to replace the rail with a stick (single, four-legged, or tripod). In this way he will gradually be able to leave the rail, using a stick only, at first with the therapist in attendance, but later alone. When training to walk using a stick only, the therapist is concerned with the balance of the patient while walking with a less stable support and continues to supervise his pattern of gait. All sticks must be provided with rubber ferrules to prevent them from slipping.

Phase 6.—When the patient is quite confident in walking alone unaided,

* The description here applies to a patient who can use only one hand. With a patient who has the use of both hands two rails or two sticks can of course be employed.

on the flat with one or two sticks, then he should go on to the stairs. Often stair practice is quite easy after he has become proficient on the flat.

Training on Stairs

Stairs for training should always be provided with two hand-rails and, whenever possible, training should be on a normal staircase rather than on a "gym stair" set. Normal stairs accustom the patient to height, to feel safe looking up or down stairs, and to undertake a reasonable number of stairs, which may be needed later. When patients are ready for stair practice they should not need to be held. The therapist should in the early days keep very close to the patient, though not touching him; descending backwards in front of him and coming upstairs forwards behind him to give him confidence. If it is known that a patient will return home to special circumstances his rehabilitation must prepare him to cope with them—for example, if a hemiplegic is to return to his home where there is only one stair rail, then he must learn to go backwards up or down, as the case may be, so that he can use the rail with his good hand. Some patients with arthritis of the hips go upstairs backwards more easily than forwards because this does not involve hip movement: by flexing the knees the patient raises his foot backwards on to the next stair above.

As a rule elderly patients need individual attention as described above and do not respond well to class work. This is because many have an impairment of vision and/or hearing, and others, again, may be unable to grasp instructions given from a distance rather than personally.

Occupational Therapy

This is partly covered by the attention to personal needs already described; but often more occupational therapy is needed. Training specifically directed to overcome a handicap or to use a weak limb calls for the most technical therapy. In addition to an attempt to restore function, the patient must be taught to live intelligently with his disability while maintaining or retraining independence for personal needs. This often calls for the use of equipment such as a below-knee iron for a hemiplegic, a splint for an arthritic, or a calliper for a fractured hip (even after surgical repair), as well as an adaptation of clothing and living conditions. Before a patient is discharged he should be trained in all the activities which he is likely to need at home, and whenever possible this should be done by an occupational therapist in a department equipped for the purpose. When available, an occupational therapist can render great service, too, by visiting the patient's home before his discharge to advise on the adaptations needed, such as type and place of chair, kitchen arrangements, rails on stairs and in toilet, bath, etc.

Speech Therapy

In many instances the hemiplegic patient with a speech defect may not recover in spite of speech therapy, and here again he must learn how best to manage his disability. Often the speech therapist and occupational therapist work in consultation with each other—another example of the importance of team work between different members of the team.

Pylons and Prostheses*

Whenever an elderly patient loses a leg—a not uncommon occurrence in old age—he should be trained to use a pylon. With young patients a pylon is almost invariably followed by a full prosthesis, but conditions in the old patient often make this impracticable. When supplying a pylon or prothesis for an elderly amputee it must be remembered that the medical conditions are entirely different from those in the case of the younger amputee. The majority of amputations in young persons are for trauma and occur in otherwise very fit individuals. In the elderly, amputations are usually undertaken for gangrene occurring in a person with a seriously damaged peripheral vascular system and often with an ischaemic heart.

If well trained, an elderly person can usually manage a pylon because it is light in weight and easy to put on. A full prosthesis is considerably heavier and rather more difficult to manage, and for these reasons it is often wiser to advise the patient to be content with the permanent use of a pylon. Requests for a full prosthesis should be considered on medical grounds, because the provision of such a prosthesis may produce cardiac failure, unsteadiness of gait, or a general loss of confidence, and in some instances cause a fall. The same arguments may be used in considering the double amputee, but in these cases the risk of development of cardiac failure is much greater and full prostheses should rarely be prescribed. For the single amputee the rehabilitation programme already described can be used, with bed-end exercises followed by training in hopping along a walking-rail and on stairs. Only when the patient can stand and walk unaided with two sticks should he be provided with a pylon, and then he will have no difficulty in walking, whether on the flat or on stairs. A special pattern of rehabilitation is needed for the double amputee.

The pattern of rehabilitation outlined can be used for elderly patients with any physical and/or mental disabilities—adapting details to the specific requirements of the individual. In each case the individual requirements need detailed study so that optimum conditions can be provided for the patient—for example,

* "The Problem of the Aged Amputee", *Postgrad. med. J.*, 1957, **33**, 436, 451.

a below-knee iron with or without a knee extension for the hemiplegic, a calliper for the fractured femur, or a pylon for the amputee. Attention to suitable footwear and to the correct height of sticks is of supreme importance.

Throughout re-education instructions should be given shortly, clearly, and concisely. With a planned programme of rehabilitation an elderly patient is less likely to become confused, as the instructions are repeated rather than varied. As part of the programme aiming at full personal independence, patients must be instructed to look after their aids and equipment—and especially to keep their sticks with them. Failure to do this makes them unnecessarily dependent upon others.

Before a patient is permitted to go home he should be confident and competent to rise from his chair unaided; take his stick (or sticks) and walk wherever he wishes to, avoiding moving objects and people; and be quite safe alone on stairs. He should also—and this is important—be able to attend to his toilet needs unaided.

FOLLOW-UP CLINIC

When the patient has been discharged home it is important that his condition should be supervised in the follow-up clinic, so that any deterioration, medical or social, may be detected and corrected early. Good follow-up includes contact with the family and others within the community—e.g. home help. It is important to understand that successful rehabilitation in hospital is only the initial stage, and becomes valueless unless it can be maintained at home. It is important, too, that the follow-up supervision should be in direct continuity with the treatment in hospital. Experience shows that this service is very valuable in maintaining progress made, and it also demonstrates that certain patients who are unsupervised may weary at home and fail to do as well as they should, sooner or later necessitating readmission to hospital.

CHAIR PATIENTS

In spite of every effort to train patients to full ambulation, there are some who will be unable to make the grade, and for these patients it is important, whenever possible, to train them to full independence as "chair patients". Treatment for such patients will obviously follow, through as many phases as possible, the lines already described. Failure usually occurs at Phase 3, and the patient either fails to stand unaided or, standing, cannot walk sideways. If after sufficient time and with an experienced therapist the patient cannot progress further, then it may often be decided that he should be provided with a self-

propelled wheel-chair to give him the maximum degree of independence. Such a chair must be selected with care according to the patient's condition.

In every case a wheel-chair should have *four wheels*—two driving wheels and two ball-bearing wheels—a brake placed in front where it can be seen and easily used, an easily manœuvred foot-piece, and solid tyres. This latter is necessary for full chair independence, avoiding the need to inflate the tyres, which cannot be done by the patient himself.

Many conditions call for special chairs—for example, a double amputee should have a chair with no foot-pieces, and the hemiplegic or the one-handed patient needs a one-hand drive. A chair with the driving wheels at the back should be used whenever suitable, because such a chair aids the posture of the patient and gives good shoulder movements. The patient with limitation of shoulder movements, however, will need a chair with the driving wheels at the front.

Not only should the patient learn to propel his chair efficiently, but he must learn to get from bed to chair and from chair to toilet, and vice versa, without assistance. There are at least two methods by which this can be done.

(1) If the patient can take some weight on his feet, then he can sit on the edge of his bed facing his wheel-chair, which has been drawn close to the bed. The level of the chair should be matched to the level of the bed and the brake should be applied. The patient should then grasp the arms of the wheel-chair, attempt to stand, and turn slowly through 180 degrees until he is sitting on the chair facing the bed.

(2) If the patient cannot take weight on his feet he will need to be trained to get from bed to chair and chair to bed using a "shuffle-board".* These patients should also be trained to get from chair to toilet and back, and for this the toilet must be provided with grab-rails.

In every case a "chair patient" should be taught and encouraged to raise himself from the seat of his chair. This is done by taking weight on the arms of the chair and lifting the trunk. He will often need a foot-stop for this exercise, but it is important for him to achieve this as it gives him freedom to alter his position if he wishes, makes it much easier for him to adjust clothing, etc., and

* The shuffle-board should be strong but light enough to be managed by crippled arthritic hands, and narrow enough to be put under the buttocks with the patient in the chair. The board consists of a piece of birch plywood, 30 by 7¾ inches, well sandpapered, polished, and mounted by panel pins to a frame of deal wood ⅞ by ⅝ inch. Tenon joints and two centre battens are used to strengthen the frame. The weight is 1 lb. 13 oz. For patients over 12 stones a stronger frame is made with a beech plywood surface and a pinewood frame. The approximate cost of the materials is 5*s*.

relieves pressure on the buttocks. Throughout chair training the patient must be kept fully independent for all his needs and as active as possible. He should understand the implications of full independence, and should not be able to get unnecessary help from staff, as this undermines training discipline.

INCURABLE PATIENTS

There will always be some patients who do not make the grade even to "chair" independence, and others who, having made the grade, will deteriorate as a result of the progress of disease or of additional pathology. For these unfortunate patients it is still important to preserve as much independence as possible and to insist that they continue to do as much as they can for themselves, as morale is most important in such conditions. The patient should dress or be dressed and sit in a chair (self-propelling if he is able to use one). Only if this is impossible should he remain *on* his bed, in conditions previously described. Even at this stage often useful adaptations can be made to help the patient, who still needs preventive and active rehabilitation.

SUMMARY

Much of the essential rehabilitation for elderly persons is simple, but this must not be used as an excuse for failing to give what is needed.

Full rehabilitation includes methods of prevention as well as active therapy, and an intelligent use of gadgets and equipment.

Full rehabilitation must be given when required to all elderly persons at home or in hospital, whether with physical and/or mental disabilities and whether fully recoverable or not.

Because of the inherent conditions of elderly persons and their tendency to deteriorate it is a responsibility of every medical man or woman, in whatever faculty or field of medicine, who treats an elderly patient to give consideration and treatment along the lines suggested. Often it may be well to seek aid from a physician interested in geriatric medicine.

Simple adaptations of chairs, beds, toilets, and stairs prevent much dependence of elderly persons upon others.

At the present time most of the specialized treatment is practised by physicians in geriatric medicine. Much unnecessary chronicity develops as a result of lack of knowledge and lack of interest in the conditions found in elderly persons.

ACKNOWLEDGMENTS

I wish to record my thanks to many medical colleagues and others for their work in the rehabilitation of elderly patients; and my especial gratitude to Dr. J. Kaminski, who has done so much work in this field.

REVIEWS OF BOOKS

MODERN TRENDS IN DISEASES OF THE VERTEBRAL COLUMN. By Reginald Nassim and H. Jackson Burrows. *Pp. 292. £3 15s. London: Butterworth. 1959.*

This book gives an excellent account of the anatomy, development, and diseases of the spine. There are 15 chapters, each written by a different contributor. Professor R. Walmsley describes the anatomy and development of the vertebral column, paying particular attention to the intervertebral disks. There is a detailed account of congenital anomalies by Mr. R. I. Harris from Toronto, followed by an authoritative discussion of the causes of scoliosis and its treatment by Professor J. I. P. James. Professor D. H. Collins gives a clear and well-illustrated description of degenerative diseases affecting the spine, and Dr. R. Nassim discusses the causes of osteoporosis. There are two short chapters on tuberculous and non-tuberculous infections by Mr. J. A. Cholmeley and Mr. J. A. Mantle, and Dr. F. Dudley Hart has written a concise and well-documented chapter on ankylosing spondylitis. Mr. Valentine Logue describes the symptoms, investigation, and treatment of cervical spondylosis. Dr. H. A. Sissons discusses tumours of the vertebral column, and there is a particularly interesting chapter on the radiology of the spine by Dr. L. S. Carstairs. The chapter on the management of spinal-cord injuries by Dr. L. Guttmann includes an important section on first aid and a detailed account of the routine treatment of patients with spinal injuries admitted to Stoke Mandeville Spinal Centre. Mr. P. H. Newman discusses the causes and treatment of low back pain and the indications for surgery, while Dr. W. Tegner deals with the difficult problem of treating patients with "functional backache". Professor N. L. Higinbotham contributes the final chapter on spinal biopsy.

The text is well illustrated by diagrams, clinical pictures, and radiographs, and each chapter is accompanied by a comprehensive list of references. It is inevitable in a book of this sort that there should be certain omissions; for example, there is no account of the musculature of the spine and no mention of the spinal lesions of rheumatoid arthritis. However, these are minor criticisms of a book which not only should be read by specialists in physical medicine but should be kept on the bookshelf for future reference.

S. MATTINGLY

THERAPEUTIC ELECTRICITY AND ULTRAVIOLET RADIATION. Edited by S. Licht. *Pp.* 373. $10. *New Haven, Conn.: Elizabeth Licht. 1959.*

This book is the fourth in the editor's series "Physical Medicine Library", and as such is in the nature of a comprehensive monograph. The editor himself contributes chapters on the history of electrotherapy and ultraviolet therapy, which are characteristically exhaustive and witty. There is a good survey of apparatus and the basic physics of electrotherapy by Reiner, and the sections on valve theory and circuitry for the electronic stimulators are particularly good. Stillwell contributes a thoughtful chapter on the clinical applications. Harris on iontophoresis and Scott on clinical uses of ultraviolet rays are in excellent form. The chapters on instrumentation for ultraviolet therapy and its physiological effects are very detailed and go well beyond a physical medicine specialist's immediate need, but are of much interest. There is a short chapter on electrosleep by the Moscow physician Obrosow, complete with

circuit diagram for sleep induction, though the technique seems more time-consuming and expensive than the use of a barbiturate.

The over-all impression of this book is that it contains all the information, amply documented, that the practising physical medicine specialist could want. The fact that the approach is less critical than one would like is in great part due to the lack of adequate controlled work in much of this subject. Perhaps this will be remedied by the time subsequent editions appear; meanwhile this book is a good survey of the field and can be recommended.

C. B. WYNN PARRY

NOTICE

INTERNATIONAL SOCIETY FOR THE WELFARE OF CRIPPLES

FILM AWARD

AN International Rehabilitation Film Award will be presented at the Eighth World Congress of the International Society for the Welfare of Cripples to be held in New York City from August 28 to September 2, 1960. Awards were previously presented at the Society's Sixth World Congress at The Hague in 1954 and at the Seventh World Congress held in London in 1957.

Eligible Films.—Any motion-picture film portraying aspects of service for the physically handicapped released after August 1, 1957, and available for showing in 16 mm. is eligible. Since the purpose of the award is to emphasize the importance of the international use of films, it is desirable that films be suitable for use in various countries.

Nomination.—The members of the International Society for the Welfare of Cripples' International Rehabilitation Film Board, member organizations of the International Society for the Welfare of Cripples, and other interested persons and organizations are invited to nominate films to receive the award. Forms for this purpose may be obtained upon request to: International Rehabilitation Film Library, 701 First Avenue, New York 17, New York.

Practical Data.—Nominated films must be made available for screening and should be addressed to: Mr. MERRITT P. BLOCH—Congress Films, International Society—Rehabilitation Film Library, 1697 Broadway, Suite 306, New York 19, New York. Films must arrive before July 1, 1960, with the following understanding: (1) Copyright of the film remains with the owner, but the International Society reserves the right to show the film to Congress participants and their guests during the time of the Congress. (2) The preview copy will be screened, evaluated, and mailed to the address of the sender by September 30, 1960, by parcel post, insured. (3) The preview copy remains the property of the sender unless otherwise indicated.

Evaluation.—Nominated films will be evaluated, upon request, by the members of the International Society's Film Board with the assistance of members of the Preview Committee and such experts in specific aspects of rehabilitation as a particular film may require. The main considerations in making the award will be "accuracy of technical services portrayed, worldwide application, attractive presentation, and appeal to intended audience".

ABSTRACTS OF THE LITERATURE

The "Normal" Lumbo-sacral Spine. N. E. CROW and B. G. BROGDON. *Radiology*, 1959, **72**, 97.

Radiographs of the lumbo-sacral spine taken from 936 healthy young males were reviewed, the double-reading technique being used. The subjects were between the ages of 17 and 27 years and were all in good general health without any back symptoms. The findings are summarized below.

Entity	No. of Cases	%
Spina bifida occulta	334	35·7
Previous Scheuermann's disease ..	194	20·7
Scoliosis greater than 1 inch ..	5	0·5
Rudimentary ribs or ununited transverse processes	60	6·4
Transitional vertebrae	108	11·5
Spondylolysis	71	7·6
Spondylolisthesis	42	4·5
Limbus vertebrae	9	1·0
Haemangioma	4	0·4
None of above variations	376	40·2

MAURICE F. HART

Studies on the Isolation and Characterisation of the "Rheumatoid Factor". H. G. KUNKEL, E. C. FRANKLIN, and H. J. MULLER-EBERHARD. *J. clin. Invest.*, 1959, **38**, 424.

To study the rheumatoid factor the authors obtained this substance in a high state of purity by several different procedures employing density gradient centrifugation. The isolated preparations were homogeneous with a corrected sedimentation constant of approximately 19 S. Free-solution electrophoresis indicates that the rheumatoid factor consists of multiple, closely related macroglobulins. It contains considerable carbohydrate—approximately 10%, made up of hexose, hexosamine, and sialic acid. The values are very close to those previously obtained for normal 19-S γ-globulin and for certain macroglobulins from the sera of patients with Waldenström's macroglobulinaemia. The possibility that the rheumatoid factor represents an antibody is discussed. The close relationship to the broad 19-S class of γ-globulins, which contain a variety of antibodies, is in favour of this hypothesis.

MAURICE F. HART

Treatment of Rheumatoid Arthritis by Sanatorium Regime. R. M. MASON and W. G. WENLEY. *Ann. rheum. Dis.*, 1959, **18**, 91.

The results of treating 40 cases of rheumatoid arthritis on a sanatorium regime at Black Notley Hospital, Braintree, Essex, are described. The average duration of the disease was 9·4 years, and all patients were partially or completely disabled. The average length of stay in hospital was 6½ months, and during this time the patients were treated on standard sanatorium lines with prolonged rest in bed, as much out-of-doors as possible, and suitable splinting. Physiotherapy and other rehabilitation procedures were limited because of lack of facilities.

There was a significant improvement in functional capacity, the proportion of cases of complete disablement decreasing from 50% to 24%, and better results were obtained in those cases where the disease was of short duration. At follow-up this improvement was usually maintained and in some cases increased.

It is concluded that sanatorium treatment for severe rheumatoid arthritis is worthwhile, but that adequate rehabilitation procedures are required.

D. A. H. YATES

Advances in Rehabilitation. H. A. RUSK. *Practitioner*, 1959, **183**, 505.

The author considers that the greatest advance in rehabilitation in recent years has been the acceptance of a new third dimension of medical responsibility. In the face of a population whose age is constantly increasing, a greater number of patients are to be expected to be suffering from the chronic diseases. Many of these patients may be saved from spending the rest of their days in hospital by active rehabilitation at an early stage. The author considers it better to have a department of rehabilitation in each general hospital rather than separate rehabilitation centres. The "homestead" scheme is described in which chronically disabled persons who are unable to find employment are housed adjacent to a general hospital, but in institutions that give them greater freedom than a hospital ward and require fewer nursing personnel.

B. G. B. CHRISTIE

MASTER INTERTHERM

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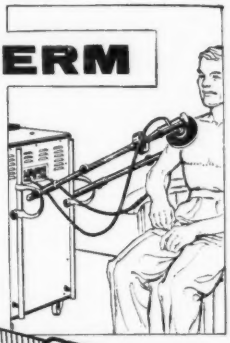

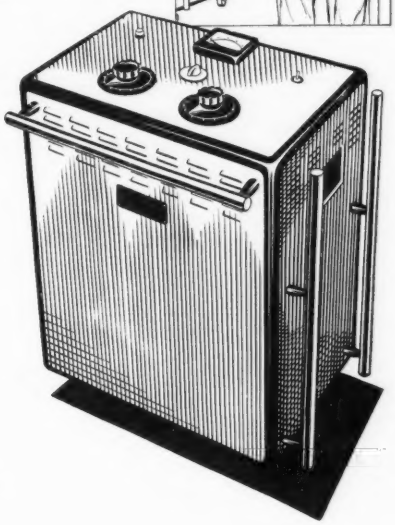

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